

**6450-01-P**

**DEPARTMENT OF ENERGY**

**10 CFR Part 490**

**RIN 1904-AA99**

**Office of Energy Efficiency and Renewable Energy**

**[Docket No. EE-RM-98-PURE]**

**Alternative Fuel Transportation Program; P-series fuels**

**AGENCY:** Department of Energy (DOE)

**ACTION:** Notice of final rulemaking

**SUMMARY:** In response to a petition filed by Pure Energy Corporation, DOE is amending the rules for the statutory program that requires certain alternative fuel providers and State government fleets to acquire alternative fueled vehicles. The regulatory amendments add three specific blends of methyltetrahydrofuran, ethanol and hydrocarbons (known as "P-series" fuels) to the definition of "alternative fuel."

**FOR FURTHER INFORMATION CONTACT:**

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**EFFECTIVE DATE:** May 17, 1999

**SUPPLEMENTARY INFORMATION:**

## **I. Introduction and Background**

### **A. Fuel Characteristics**

On June 30, 1997, Pure Energy Corporation petitioned DOE for a rulemaking to add its proprietary fuel products to the definition of “alternative fuel” under the Alternative Fuel Transportation Program (Program) regulations (10 CFR part 490). DOE published in the Federal Register the proposed rulemaking on July 28, 1998. 63 FR 40202. Pure Energy Corporation’s P-series fuels are blends of ethanol, methyltetrahydrofuran (MTHF), and pentanes plus, with butane added to blends that would be used in severe cold-weather conditions to meet engine cold start requirements. Pure Energy Corporation has represented that both the ethanol and the MTHF will be derived from renewable resources, such as cellulosic biomass from waste paper, agricultural waste and urban/industrial wood waste. Pure Energy Corporation plans to use pentanes plus derived from the processing and production of natural gas, as opposed to those derived from petroleum refining processes. Pure Energy Corporation holds the exclusive worldwide license to manufacture and distribute the P-series fuels, which were developed by Dr. Stephen Paul of Princeton University. The P-series fuels were awarded Patent number 5,697,987 by the United States Patent and Trademark Office on December 16, 1997. DOE’s evaluation of Pure Energy Corporation’s petition is restricted to three of the formulations covered under this patent.

To make the P-series fuels, Pure Energy Corporation will be producing ethanol and MTHF through an integrated process. The company expects to use commercially

proven concentrated acid hydrolysis as its base technology for this integrated production process. MTHF is currently produced in limited quantities from furfural (derived from both biomass and petroleum feedstocks) for use as a specialty chemical in consumer products and/or process industries. Pure Energy Corporation has developed a thermochemical technology to produce MTHF from cellulosic feedstocks through a levulinic acid pathway. Levulinic acid is a crystalline keto acid obtained by action of dilute acids on hexoses (six-carbon sugars like glucose or fructose) and on substances, such as starch or sucrose, that yield hexoses on hydrolysis. The company integrates this process with an ethanol production system to achieve technical and economic efficiencies. In this process, the lignocellulosic feedstock is converted into both five- and six-carbon sugars, which are then bifurcated into fermentation and thermochemical pathways to produce ethanol and MTHF, respectively.

Pure Energy Corporation has developed several formulations of the P-series fuels. The company proposes to vary the components of its P-series fuels to meet particular market demands. The three formulations described in Table 1 (Pure Regular, Pure Premium and Pure Cold Weather) are those for which Pure Energy Corporation, in its petition, provided specific energy and emissions data. The company claims that the volumetric percentages of each of the components of the P-series fuels can range from 10 percent to 50 percent for pentanes plus; from 15 percent to 55 percent for MTHF; from 25 percent to 55 percent for ethanol; and from zero to 15 percent for normal butane. Table 1 provides the compositions, by volume, of the three specific

P-series fuel formulations which are the subject of this rulemaking.

Table 1

Volume Composition of the P-series Fuels			
Constituent	Regular	Premium	Cold Weather
Pentanes plus	32.5%	27.5%	16.0%
MTHF	32.5%	17.5%	26.0%
ethanol	35.0%	55.0%	47.0%
normal butane	0.0%	0.0%	11.0%

Based on the data supplied in the petition, the composition of P-series fuels varies from 60 to 100 percent non-petroleum, on an energy basis, depending on the source of the pentanes plus and n-butane components of the blends.

Pure Energy Corporation intends to market the P-series fuels to owners of flexible fuel vehicles (FFVs) designed to operate on E-85 (85 percent ethanol/15 percent gasoline), on gasoline, or on any blend of those two fuels. Flexible fuel vehicles are currently available from two major domestic auto manufacturers as mid-size sedans, minivans and compact pickup trucks.

#### B. Patent

On December 16, 1997, the United States Patent and Trademark Office issued U.S. Patent No. 5,697,987, titled Alternative Fuel, to Princeton University on a new non-petroleum fuel, for spark-ignition engines, called the P-series. The United States Patent and Trademark Office's abstract for this patent reads:

A spark ignition motor fuel composition consisting essentially of: a hydrocarbon component containing one or more hydrocarbons selected from five to eight carbon atoms straight-chained or branched alkanes essentially free of olefins, aromatics, benzene and sulfur, wherein the hydrocarbon component has a minimum anti-knock index of 65 as measured by ASTM D-2699 and D-2700 and a maximum DVPE of 15 psi as measured by ASTM D-5191; a fuel grade alcohol; and a co-solvent for the hydrocarbon component and the fuel grade alcohol; wherein the hydrocarbon component, the fuel grade alcohol and the co-solvent are present in amounts selected to provide a motor fuel with a minimum anti-knock index of 87 as measured by ASTM D-2699 and D-2700, and a maximum DVPE of 15 psi as measured by ASTM D-5191. A method for lowering the vapor pressure of a hydrocarbon-alcohol blend by adding a co-solvent for the hydrocarbon and the alcohol to the blend is also disclosed.

### C. Background

10 CFR part 490 implements, in part, title V of the Energy Policy Act of 1992 (EPACT) (Public Law 102-486) which mandates alternative fueled vehicle acquisition requirements for certain alternative fuel providers and State government fleets. Part

490 is one of a variety of EPACT programs to promote alternative and replacement fuels that reduce reliance on imported oil, reduce criteria pollutant and greenhouse gas emissions, increase energy efficiency, and help displace 10 percent of conventional motor fuels by 2000 and 30 percent by 2010.

Title III of EPACT requires Federal fleet acquisitions of alternative fueled vehicles. Title IV includes specific authority for a financial incentive program for States, a public information program, and a program for certifying alternative fueled vehicle technician training programs. In addition to the mandates for the purchase of alternative fueled vehicles by certain alternative fuel providers and State government fleets, title V provides for a possible similar mandate for certain private and municipal fleets. Title VI provides for a program to promote electric motor vehicles.

The types of vehicles that satisfy the alternative fuel provider and State government fleet mandates in title V are determined in part by the definition of "alternative fuel" in section 301(2). That definition provides: "'Alternative fuel' means methanol, denatured ethanol, and other alcohols; mixtures containing 85 percent or more (or such other percentage, but not less than 70 percent, as determined by the Secretary, by rule, to provide for requirements relating to cold start, safety, or vehicle functions) by volume of methanol, denatured ethanol , and other alcohols with gasoline or other fuels; natural gas; liquefied petroleum gas; hydrogen; coal-derived liquid fuels; fuels (other than alcohol) derived from biological materials; electricity (including electricity from solar energy); and any other fuel the Secretary determines, by rule, is substantially not petroleum, and would yield substantial energy security benefits and

substantial environmental benefits." [Emphasis added.] 42 U.S.C. 13211(2). The emphasized phrase in the definition of "alternative fuel" states the minimum procedural and substantive requirements for adding a new fuel blend to the list of fuels enumerated or implicitly covered by the provisions of section 301(2).

For reasons set forth in detail below, DOE determines that the three P-series fuels described in Pure Energy Corporation's petition (Pure Regular, Pure Premium and Pure Cold Weather) and by United States Patent number 5,697,987, which contain at least 60 percent non-petroleum energy content derived from MTHF, which must be manufactured solely from biological materials, and ethanol, which must be manufactured solely from biological materials, are substantially not petroleum and would yield substantial energy security benefits and substantial environmental benefits, and thus are hereby added to the definition of "alternative fuel" in 10 CFR 490.2.

## **II. Discussion of Public Comments**

### **A. Pure Energy Corporation Comments**

Pure Energy Corporation, the petitioner, was among those submitting comments to DOE in response to the Notice of Proposed Rulemaking (NPR) (63 FR 40202). In the NPR, DOE noted that neither the Energy Policy Act of 1992 (the Act), nor the language of legislative committee reports, provides any guidance on how to measure whether a fuel is "substantially non-petroleum." The word "substantially," DOE observed, "...is sometimes used as a synonym for the word 'mainly'" and "...at other times as a synonym for the words 'considerably' or 'importantly.'" Whether to construe

“substantially” in the first, narrower sense or in the latter, broader one, DOE said, was a policy question. DOE further said, “Obviously, a fuel that is more than 50 percent non-petroleum in energy-equivalent terms is ‘mainly’ and therefore ‘substantially non-petroleum.’” ( 63 FR 40204). Fuels of less than 50 percent non-petroleum content could still be regarded as “substantially non-petroleum” if “substantially” were construed in the broader sense, DOE reasoned, since such fuels could be regarded as “considerably” or “importantly” non-petroleum. Because all three of the P-series fuel formulations Pure Energy Corporation described in its petition are more than 60 percent non-petroleum in energy terms, DOE elected not to address the policy question of whether to construe “substantially” in the narrow or broad sense. DOE proposed to designate P-series fuel blends as alternative fuels if, like the three P-series blends described in Pure’s petition, they are at least 60 percent non-petroleum in energy terms.

In its comments, Pure Energy Corporation endorsed DOE’s statement regarding fuels of 50 percent or greater non-petroleum content. The company went on to state its belief that “...50 percent minimum non-petroleum energy content is the right standard as a matter of law and public policy...” The company submitted data on a fourth P-series formulation it claimed meets the standards for “substantial energy security benefits” and “substantial environmental benefits,” but which is 52.3 percent non-petroleum in energy content. Pure Energy Corporation requested that DOE, in its final rulemaking, set a minimum non-petroleum energy content for P-series fuels at 50 percent, rather than at the 60 percent level proposed in the NOPR.



The vehicle emissions test data for the fourth P-series blend submitted by Pure Energy Corporation with its comments were inconclusive. Therefore, DOE asked the company to submit additional data. In order to proceed in an expeditious manner, DOE is electing to proceed with the final rule on the three P-series blends described in Pure Energy Corporation's original petition, and will address the fourth formulation when we receive the additional data.

#### B. Other Public Comments

In addition to Pure Energy Corporation, forty-two other firms, organizations and individuals submitted comments in response to the NOPR. The majority of these spoke in favor of granting Pure Energy Corporation's petition, with none of their comments raising a significant issue regarding the rule. Three commenters, however, raised objections to DOE's granting the petition. Their comments and DOE's responses to them are summarized below.

One commenter raised the possibility that reactions could occur between the methyltetrahydrofuran (MTHF) component of P-series fuels and metallic engine components containing molybdenum. (For example, molybdenum is sometimes used as a "facing" material on engine piston rings.) The commenter expressed concern that such reactions could degrade those components and lead to the formation of hydrogen which could in turn lead to hydrogen embrittlement of engine parts. This commenter cited work reported in the *Bulletin of the Korean Chemical Society* in which molybdenum atoms were observed to break apart the chemical bonds in MTHF, among

other compounds.

DOE's examination of the work cited revealed that the Korean researchers had vaporized a molybdenum wire with very high electric currents to produce free molybdenum atoms. Molybdenum's melting point is over 4750 EF. and its boiling point is over 8380 EF. These temperatures are far higher than any actually experienced by any part of an internal combustion engine. Thus, there is little likelihood that free molybdenum atoms could be liberated from molybdenum-bearing engine parts to react in the gas phase with MTHF. Moreover, hydrogen embrittlement is not a problem in current engines, despite the fact that free hydrogen may be produced as a combustion intermediate whenever any hydrogen-bearing fuel is used. Therefore, there is no reason to expect that P-series fuels will engender hydrogen embrittlement problems.

The commenter raised the possibility that molybdenum could also lead to similar hydrogen-related problems in fuel storage systems. Molybdenum is a key ingredient in hydro treating catalysts. These catalysts are used in refining processes which remove sulfur from petroleum and natural gas liquids and otherwise improve their properties. The commenter suggested that molybdenum would be carried over from these catalysts in the pentanes plus and subsequently react with other P-series fuel components to generate hydrogen by the same reactions the commenter had proposed would occur in engines. This problem does not exist with other fuels that have undergone hydro treatment, so it is unlikely it will exist with P-series fuels. In hydro treating catalyst formulations, molybdenum exists in the form of molybdenum disulfide, not as metallic molybdenum. The Korean research that the commenter cited indicates that metallic

molybdenum and extremely high temperatures are needed to promote the reactions the commenter fears will lead to hydrogen formation.

Finally, noting the high ethanol content of P-series fuels, this commenter expressed the concern that contamination of the fuels by water would lead to fuel phase separation. DOE believes the fuels industry has accumulated ample experience in handling and distributing fuels containing varying proportions of ethanol over the past 20 or more years to prevent this from being a concern.

A second commenter, citing P-series' "wide variation in petroleum content (the butane and pentanes plus)," urged DOE to resolve the issue of "...whether P-series fuel meets the definition of 'substantially non-petroleum.'" As DOE noted in the NOPR, the P-series fuels that are the subject of this rulemaking are a *minimum* of 63.8 percent non-petroleum on an energy basis, and DOE regards this as sufficient to qualify them as "substantially non-petroleum." Further, the butane and pentanes plus may as easily be derived from natural gas processing as from petroleum refining, and hence may also be non-petroleum. In that case, P-series fuels would be 100 percent non-petroleum.

The commenter also pointed out that, "Fuels must also have tightly controlled specifications for proper combustion and vehicle operation. It is critical that performance-based fuel specifications be established and enforced." Lack of such specifications, the commenter said, would increase the difficulty vehicle manufacturers would encounter in meeting increasingly stringent emissions standards and permit wide variations of in-use fuel properties. This in turn would "limit vehicle manufacturer and consumer interest in these fuels." DOE recognizes the validity of this concern, but the

establishment of practical, detailed fuel specifications lies outside DOE's authority. Traditionally, such specifications are arrived at through a consensus of fuel producers and users, based on economics and performance. The American Society for Testing and Materials (ASTM) provides one example of an appropriate forum for achieving such a consensus. DOE will be available to assist those organizations with the establishment of detailed fuel specifications for the P-series fuels.

Finally, the commenter pointed out that existing flexible fuel vehicle products have not been designed to operate on P-series fuels and have not been validated for operation on these fuels, notwithstanding the emissions testing carried out by Pure Energy Corporation. "It would be inappropriate to state or imply such a capability," the commenter said. The commenter added that use of P-series fuels in existing flexible fuel vehicles or in future vehicles not certified with P-series fuels could void the manufacturers' warranties. DOE also acknowledges the validity of these comments. DOE has not stated or implied, by granting alternative fuel status to P-series fuels, that available vehicles were manufactured to operate on the fuels or that use of the fuels will not void vehicle warranties. How and under what circumstances to honor product warranties is the responsibility of the vehicle manufacturers, and DOE's decision to grant the P-series fuels alternative fuel status in no way limits manufacturers' prerogatives in this regard. Ultimately, it will be up to vehicle manufacturers to determine the effects of fuels on their products and to decide whether they wish to test or certify their vehicles on those fuels.

A third commenter opposed the designation of P-series fuels as alternative fuels

under the Act. This commenter stated the belief "...that a fuel mixture that contains only 60 percent non-petroleum fuel should not be classified as an alternative fuel." DOE disagrees with this statement and stands by the reasoning that led to its initial affirmative determination to proceed with a rulemaking, as explained in the NOPR. "Furthermore," the commenter went on, "there is no assurance that the fuels under consideration actually will have even this level of non-petroleum content, since some of the components of the fuels can come from petroleum or non-petroleum feedstocks." This comment appears to arise from a misreading of the NOPR. In fact, the *minimum* non-petroleum content of the P-series fuels that are the subject of this rulemaking is 63.8 percent (on an energy basis). If the balance of the blend constituents are from natural gas processing, the blend will be wholly (100 percent) from non-petroleum sources.

In evaluating the P-series fuels, and in light of feedback received that expressed concerns similar to those of the above commenter, DOE became concerned that Pure Energy Corporation would have the ability to utilize ethanol that is not manufactured from biomass or biological materials. It is possible to manufacture ethanol from petroleum, for example, by the hydration of ethylene. DOE believes that Pure Energy Corporation fully intends to manufacture the ethanol included in the P-series fuels from biological materials. However, because DOE has some concerns about the availability of biologically derived ethanol, it was decided to limit the ethanol feedstock for the P-series fuels to biological materials. Therefore, the parenthetical phrase "manufactured

solely from biological materials” has been added to the regulatory language as a qualifier for the ethanol feedstock.

The commenter also raised several procedural objections to DOE’s proposed granting of alternative fuel status to Pure’s P-series fuels. The first of these is the commenter’s contention that “DOE must define new alternative fuel blends in the same way existing blends are defined.” According to the commenter, “In attempting to expand the list of alternative fuels, DOE has improperly construed the statute’s requirement that new fuels must be ‘substantially non-petroleum.’ Moreover, in interpreting the term ‘substantially,’ DOE has completely ignored the guidelines established for fuel blends/mixtures explicitly recognized in the Act.” The commenter’s reference is to section 301(2) of the Act, which says (in part): “the term ‘alternative fuel’ means methanol, denatured ethanol, and other alcohols; mixtures containing 85 percent or more (or such other percentage, but not less than 70 percent, as determined by the Secretary, by rule, to provide for requirements relating to cold start, safety, or vehicle functions) by volume of methanol, denatured ethanol, and other alcohols with gasoline or other fuels...”

The commenter claims that in identifying specific fuels and fuel blends deemed to be alternative fuels, the Act established guidelines that DOE must adhere to in making subsequent determinations. In particular, the commenter believes section 301(2) of the Act “...explicitly forbid[s] the inclusion of ethanol fuel blends where the ethanol component of the mixture is less than 85 percent,” and that, “[t]here is no statutory basis for designating as alternative fuels blends that contain considerably

more petroleum than the blends listed in the statute.”

DOE believes that the commenter has misinterpreted the Act. In conferring explicit alternative fuel status on ethanol blends of 85 volume percent and above, DOE does not believe Congress intended implicitly to reject all ethanol blends of less than 85 volume percent. Indeed, the Secretary of Energy is granted discretion under certain circumstances to approve ethanol blends containing as little as 70 percent ethanol. Nor does DOE believe that the Congress, by providing a list of alternative fuels, was enunciating overarching principles that it intended DOE to follow in future determinations. Rather, Congress delineated such principles explicitly in section 301(2) when it said that the definition of “alternative fuel” could include “... any other fuel the Secretary determines, by rule, is substantially non-petroleum and would yield substantial energy security benefits and substantial environmental benefits” [Emphasis added]. The commenter’s inferences regarding Congressional intent cannot be reconciled with this explicit language. Finally, as noted above, the P-series blends do not necessarily or always contain any petroleum component.

The three criteria enumerated in section 301(2), which DOE has used in making this determination (and, as directed by Congress, will be used in making future determinations) represent a rigorous standard by which to measure the efficacy of potential alternative fuels in achieving the overall goals of the Energy Policy Act. DOE believes that analysis of potential alternative fuels by these criteria is appropriate and statutorily required.

The commenter also expressed the view that DOE erred in making its

determination of whether a fuel is substantially non-petroleum on the basis of the fuel's energy content, rather than on the basis of the volume of the fuel that is non-petroleum. The commenter said, "DOE's notice [the NOPR] indicates that, since the energy displacement goals contained in EPACT are measured in terms of energy equivalent units, DOE also may evaluate a fuel's non-petroleum content based on energy displacement rather than volume displacement." The commenter went on, " Section 301(2) actually dictates that the blended fuels recognized in the Act must contain at least 70 percent *by volume* of ethanol, methanol or alcohol. Looking at the statute and the specific section under review reveals that Congress intended these fuels to be compared based on volume not energy displacement." [Emphasis in original] Here again, DOE believes the inferences the commenter draws from section 301(2) of the Act regarding Congressional intent are incorrect. Nothing in the portion of section 301(2) that lists fuels Congress designated as alternative fuels at the time of the Act's passage can be read as establishing rigorous standards DOE is obliged to apply in future alternative fuel determinations. In addition to the neat and blended alcohol fuels, Section 301(2) lists natural gas and hydrogen. These alternative fuels are gases whose volume depends on the pressure and temperature under which they are stored. Energy content (energy displacement potential) is the only reasonable basis on which to compare them to the liquid fuels. This is also an appropriate basis of comparison since all transportation prime movers which might use any of these fuels are dependent on fuel energy content, rather than fuel volume.



### III. Statutory Criteria for Designating Additional Alternative Fuels

Neither section 301(2) nor any other provision of the Act states specifically or indicates how to measure whether a new fuel: (1) is "substantially not petroleum" and (2) would yield "substantial energy security benefits;" and (3) would yield "substantial environmental benefits." Moreover, the Act does not state that these criteria are exclusive; in appropriate circumstances, DOE could consider other criteria related to achievement of the purposes of the Program.

Legislative committee report language likewise does not identify *specifically* what numbers and measures Congress viewed as defining the minimums that would qualify as substantially not petroleum, and that would satisfy the substantial energy security and substantial environmental benefits criteria. However, the report of the House Committee on Energy and Commerce described the pertinent language in section 301(2) as providing "...the Secretary with the opportunity to add alternative and replacement fuels that are not now being marketed to those specifically identified in the legislation." [Emphasis added.] H.R. Rep. No. 474(1), 102nd Cong., 2nd Sess., 182, reprinted in 1992 U.S. Code Cong. & Admin. News 2005. The word "opportunity" suggests that the authority to add fuels to the definition of "alternative fuel" is largely discretionary.

In evaluating the P-series fuels, DOE asked the National Renewable Energy Laboratory and Argonne National Laboratory to review the data presented in Pure Energy Corporation's petition against the statutory criteria for designating an "alternative fuel." Copies of these evaluations, written comments received, technical

reference materials mentioned in the notice, and any other docket material received may be read and copied at the DOE Freedom of Information Reading Room, U.S. Department of Energy, Room 1E-090, 1000 Independence Ave., S.W., Washington, DC 20585, telephone (202) 586-3142, between the hours of 8:30 a.m. and 4:30 p.m., Monday through Friday, except Federal holidays. The docket file material will be filed under "EE-RM-98-PURE."

#### A. Substantially Not Petroleum

Any standard dictionary or thesaurus indicates that "substantially" is an adverb that can be used to convey a variety of subtly different meanings. "Substantially" is sometimes used as a synonym for the word "mainly." At other times, it is used as a synonym for the words "considerably" or "importantly." See, e.g., *Webster's New World Thesaurus* 725 (Simon & Schuster, 1985). Since this rulemaking does not involve fuels that are less than 50 percent non-petroleum, in terms of energy content, it is unnecessary to address this policy question.

Section 502(b) of the Act establishes goals for replacing the projected consumption of motor fuel in the U.S. on an energy equivalent basis. The goals provided by this section are that 10% of the motor fuel consumed by 2000 and 30% of the motor fuel consumed by 2010 will be replacement fuels. These goals are the driving force for all the alternative and replacement fuel provisions in the Act. Because the achievement of these goals is to be measured on an energy equivalent basis, DOE believes that, when evaluating a fuel, the determination of whether it is "substantially not petroleum" should be based on an analysis of the fuel's non-petroleum energy

content, rather than a volumetric analysis of the fuel's non-petroleum content.

Pure Energy Corporation claims that, on an energy basis, its three P-series fuels will be at least 60 percent derived, and may be up to 100 percent derived, from non-petroleum sources, depending on the source of the light hydrocarbons in the blends. In its petition, the Pure Energy Corporation provided DOE with information and analysis to substantiate these claims. DOE confirms the accuracy of Pure Energy Corporation's claim regarding the energy-based non-petroleum content of the P-series fuels. Table 2 summarizes the worst-case (lowest non-petroleum) makeup of the three P-series fuel formulations, based on the net (lower) heating value of all constituents.

Table 2

Verified Non-petroleum Energy Content of the P-series Fuels			
Constituent	Regular	Premium	Cold Weather
Pentanes plus	36.2%	33.3%	19.1%
MTHF	37.7%	22.1%	32.3%
ethanol	26.1%	44.6%	37.5%
normal butane	0.0%	0.0%	11.2%
<b>Non-petroleum</b>  (excluding pentanes plus, butane)	<b>63.8%</b>	<b>66.7%</b>	<b>69.8%</b>

It is evident to DOE that the MTHF and ethanol components of the P-series fuels, as described in Pure Energy Corporation's petition, will be non-petroleum, because they will be manufactured from biological materials. However it is less clear whether the pentanes plus component is non-petroleum. DOE's Energy Information

Administration (EIA), in its publication *Annual Energy Review 1996*, 386 ((DOE/EIA-0384(96)) defines “pentanes plus” as “a mixture of hydrocarbons, mostly pentanes and heavier, extracted from natural gas. [This] includes isopentane, natural gasoline, and plant condensate.” This same publication also defines petroleum products as including “unfinished oils, liquefied petroleum gases, *pentanes plus*, aviation gasoline, motor gasoline, naphtha-type jet fuel, kerosene-type jet fuel, kerosene, distillate fuel oil, residual fuel oil, petrochemical feedstocks, special naphthas, lubricants, waxes, petroleum coke, asphalt, road oil, still gas, and miscellaneous products.” However, it is unnecessary to determine whether to restrict pentanes plus on the basis of source because the MTHF and ethanol, which must be manufactured solely from biological materials, are present in all three fuel blends, result in a non-petroleum energy content for the P-series formulations of at least 63.8 percent. That percentage is the main or predominant portion of the fuel, and even under the narrow definition of “substantially,” the three fuel blends are “substantially not petroleum.”

Because U.S. Patent number 5,697,987 does not specifically define the composition of the three P-series fuels, DOE has determined that the fuels need to be more specifically described before they can be added to the regulatory definition of “alternative fuel.” Given that the petition shows that the three P-series fuels will be at least 60 percent derived from non-petroleum sources, and the fact that Pure Energy Corporation claims that, on an energy basis, its three P-series fuels will be at least 60 percent derived from non-petroleum sources, DOE is using that percentage in the rule as a way of more narrowly defining the three P-series fuels. DOE believes that the

amount of MTHF and ethanol in the fuel blends will result in a non-petroleum content of at least 60 percent for the three P-series fuels, absent any other non-petroleum component, if the MTHF and the ethanol are manufactured solely from biological materials. Although, based on our evaluation, DOE could have established a non-petroleum content of 63.8 percent for the P-series fuels, establishing the minimum percentage of 60 percent provides the company with some processing flexibility.

On the basis of the foregoing, DOE has concluded that the three P-series fuels, as described by United States Patent number 5,697,987, which contain at least 60 percent non-petroleum energy content derived from MTHF, which must be manufactured solely from biological materials, and ethanol, which must be manufactured solely from biological materials, are “substantially not petroleum” as that phrase is used in section 301(2) of the Act.

#### B. Substantial Energy Security Benefits

Pure Energy Corporation claims in its petition that the three P-series fuels are 100 percent domestic and capable of displacing gasoline on essentially a gallon-for-gallon basis. Pure Energy Corporation notes that each gallon of the P-series fuel directly displaces 0.88 gallons of RFG in vehicle use. Pure Energy Corporation also states that the energy required to produce a one-gallon-equivalent of the fuel is approximately 13,800 BTU less than that required to produce one gallon of RFG.

The petition provides information to support a claim that production of the P-series fuels results in a positive energy balance. The process efficiency (BTUs

produced per BTU of input) of the P-series fuels is approximately 2.25 when the ethanol is produced from renewable resources such as biomass. If, however, the ethanol is produced from corn, the process efficiency is slightly lower, with a value between 1.75 and 1.88. Although the process efficiency is slightly lower when the ethanol is derived from corn, production of ethanol from either feedstock represents a significant energy savings for the life cycle of the fuel.

DOE analyses support Pure Energy Corporation's claim of significant petroleum displacement, although the company's claim of 100 percent domestic content appears to be slightly high.

It is estimated that the P-series fuels (regular grade) with pentanes plus derived from natural gas would be 96 percent derived from domestic resources. It is believed that the feedstock for ethanol and MTHF production will almost certainly be wholly domestic. Since the feedstock for the pentanes plus and the butane will be either natural gas or petroleum, and because a portion of these feedstocks is currently and will continue to be imported, it is debatable whether the P-series fuels will ever be wholly derived from domestic resources. If the pentanes plus were derived from refining petroleum, at oil import levels projected by EIA for 2015, the regular grade P-series fuel would still be 80 percent derived from domestic resources.

DOE also estimates that the P-series fuels could reduce fossil energy use by 49 to 57 percent, relative to RFG, and that the P-series fuels could reduce petroleum use by 79 to 81 percent, relative to RFG.

On the basis of the foregoing, DOE has concluded that the three P-series fuels,

as described by United States Patent number 5,697,987, which contain at least 60 percent non-petroleum energy content derived from MTHF, which must be manufactured solely from biological materials, and ethanol, which must be manufactured solely from biological materials, would yield “substantial energy security benefits” as that phrase is used in section 301(2) of the Act.

### C. Substantial Environmental Benefits

Pure Energy Corporation had vehicle tailpipe and evaporative emissions tests conducted by an Environmental Protection Agency (EPA) contract automotive test laboratory using both the current Federal Test Procedure (FTP) and the US06 test. (A description of the US06 test can be found in the NOPR at 63 FR 40205 and in the Code of Federal Regulations at 40 CFR part 86.)

Pure Energy Corporation’s test vehicles, two 1997 Ford Taurus E-85 flexible-fuel vehicles, were operated on eight fuels: three P-series fuels (regular, premium and cold weather), E-85, Federal Certification gasoline, California Phase II RFG and two commercial gasolines (a summer and a winter blend). The results were submitted to DOE as part of the company’s petition. Pure Energy Corporation also provided an analysis of greenhouse gas emissions associated with production, distribution and use of the three P-series fuels and compared them to those of gasoline and E-85.

Both the criteria pollutant emissions test results and the greenhouse gas analysis support Pure Energy Corporation’s claim of substantial environmental benefits arising from the use of the P-series fuels. Criteria pollutant emissions from the P-series

fuels were consistently among the lowest of all test fuels, met Federal Tier 1 standards and statutorily provided Federal Tier 2 standards in every case, and compared favorably with those from E-85. The premium P-series fuel had better emission characteristics than the regular P-series fuel. The P-series fuels reduced emissions of non-methane hydrocarbons (NMHC) and total hydrocarbons by almost a third compared to Phase 2 RFG. It is worth noting that all of the fuels tested had evaporative emissions well below the evaporative emissions standard for Federal Tier 1. Table 3 summarizes the results of the FTP emissions results (all results in grams per mile). The numbers are averages over both cars tested and all FTP tests performed, as presented in Pure Energy Corporation's petition.

Table 3

Comparison of Federal Test Procedure Emission Results (gram/mile)			
	NMHC	Carbon Monoxide	Nitrogen Oxides
Pure Regular	0.074	1.081	0.064
Pure Premium	0.064	1.062	0.059
Phase II RFG	0.115	1.247	0.039
Tier 1 standards	0.250	3.4	0.4
Tier 2 standards	0.125	1.7	0.2

The Tier 2 standards referenced in Table 3 are the pending standards identified by Congress in section 202(i) of the Clean Air Act (CAA). A discussion of the process EPA is undertaking to establish Tier 2 standards can be found in the NOPR.

As noted in Table 4, the P-series fuels had reduced ozone-forming potential



(OFP), carbon monoxide and air toxics emissions. Table 4 compares the emission results of the P-series fuels, Indolene, Phase II RFG and commercial gasoline to EPA's National Ambient Air Quality Standards (NAAQS). [40 CFR part 63]

The OFP is a measure of the performance of the fuel-vehicle combination, calculated by multiplying the fraction of each emissions compound by its reactivity. The specific reactivity is calculated by dividing the OFP by the mass of the non-methane organic gaseous emissions. It is considered a better gauge of the reactivity of the fuels' emissions profiles. The numbers are averages of both cars tested and all FTP and US06 tests performed, as presented in Pure Energy Corporation's petition.

Table 4

Comparison of emission results related to NAAQS (gram/mile)								
	CO		NO <sub>x</sub>		OFP		Spec. React.	
	FTP	US06	FTP	US06	FTP	US06	FTP	US06
Indol.	1.421	11.99	0.056	0.040	0.488	0.470	3.248	3.092
RFG II	1.247	10.56	0.039	0.049	0.469	0.379	3.640	3.059
Comm. Gas	1.427	12.07	0.095	0.077	0.522	0.501	3.334	3.070
E85	1.218	5.15	0.056	0.079	0.494	0.087	2.410	3.633
Pure Reg.	1.081	6.15	0.064	0.057	0.305	0.161	3.360	3.460
Pure Prem.	1.062	6.23	0.059	0.081	0.282	0.158	2.849	3.568

The petition stated that the total emissions resulting from the production of a

gallon of P-series fuels are 71 percent lower than those associated with production of one gallon of Phase II RFG. Of note are the claims that emissions are reduced, relative to Phase II RFG, by more than 99 percent for methane, by 85 percent for SO<sub>x</sub>, by 71 percent for carbon dioxide and by 68 percent for nitrogen oxides.

The petition claims that the P-series fuels perform better than Phase II RFG or Indolene in terms of direct carbon dioxide emissions and that P-series fuels will result in significant reductions in carbon dioxide emissions when considered on a life-cycle basis. If the P-series fuels are produced from biomass, as Pure Energy Corporation plans to do, it is claimed that a significant percent of the carbon emissions associated with the gasoline life-cycle will be avoided. Specifically, the company estimates that the P-series regular fuel, on a life-cycle basis, will reduce carbon dioxide emissions by at least 63 percent.

DOE assessed the emissions test results and analyzed the full fuel cycle greenhouse gas emissions of the P-series fuels. DOE confirmed that regular and premium formulations of the P-series fuels displayed carbon monoxide, nitrogen oxides and non-methane hydrocarbon equivalent emissions that met the Tier 1 and statutorily provided Tier 2 standards, and that their evaporative emissions were well below the Tier 1 standards. DOE notes that the emissions of air toxics from the P-series fuels were lower than those from all other test fuels, both in terms of total mass emissions and in terms of their potency weighted toxics (PWT) emissions. The PWT weighs each individual component by a factor that represents its relative toxicity.

DOE's evaluation of the full fuel cycle greenhouse gas emissions of the P-series

fuels confirmed that, over their entire production, distribution and end-use cycle, the P-series fuels will result in greenhouse gas emissions 45 to 50 percent below those of reformulated gasoline. These reductions in greenhouse gas emissions are possible if both the ethanol and the MTHF components of the P-series fuels are made from biological materials, which is Pure Energy Corporation's intention.

On the basis of the foregoing, DOE has concluded that the three P-series fuels, as described in Pure Energy Corporation's petition and by United States Patent number 5,697,987, which contain at least 60 percent non-petroleum energy content derived from MTHF, which must be manufactured solely from biological materials, and ethanol, which must be manufactured solely from biological materials, would yield "substantial environmental" benefits as that phrase is used in section 301(2) of the Act.

#### **IV. Regulatory and Procedural Requirements**

##### **A. Review Under Executive Order 12866**

Today's regulatory action has been determined not to be a "significant regulatory action" under Executive Order 12866, "Regulatory Planning and Review," 58 FR 51735 (October 4, 1993). Accordingly, this rulemaking has not been reviewed by the Office of Information and Regulatory Affairs of the Office of Management and Budget (OMB).

##### **B. Review Under Executive Order 12612**

Executive Order 12612, "Federalism," 52 FR 41685 (October 30, 1987) requires that regulations, rules, legislation and other policy actions be reviewed for any

substantial direct effect on States, on the relationship between the National Government and the States, or in the distribution of power and responsibilities among various levels of government. If there are substantial effects, the Executive Order requires the preparation of a federalism assessment to be used in all decisions involved in promulgating and implementing policy action. DOE has analyzed this rulemaking in accordance with the principles and criteria contained in Executive Order 12612, and has determined there are no federalism implications that would warrant the preparation of a federalism assessment. The rule promulgated today would simply allow an additional fuel to qualify as an alternative fuel for the purposes of the Energy Policy Act of 1992. The rule would not have a substantial direct effect on States, the relationship between the States and Federal Government, or the distribution of power and responsibilities among various levels of government.

### C. Review Under the Regulatory Flexibility Act

The Regulatory Flexibility Act, 5 U.S.C. 601 et seq., requires preparation of an initial regulatory flexibility analysis for every rule which by law must be proposed for public comment, unless the agency certifies that the rule, if promulgated, will not have a significant economic impact on a substantial number of small entities. Today's rule would provide an additional fuel choice for organizations which must comply with the requirements of the Alternative Fuel Transportation Program (10 CFR part 490) and the requirements for Federal fleets under Title III of EPACT. There is no reason to anticipate any adverse impact. DOE certified in the notice of proposed rulemaking that

the rule will not have a significant economic impact on a substantial number of small entities. DOE received no comments on that certification.

#### D. Review Under the National Environmental Policy Act

The rule identifies the P-series fuels as “alternative fuel” as that term is defined in the Alternative Fuel Transportation Program regulations (10 CFR 490.2) and section 301(2) of the Energy Policy Act (42 U.S.C. 13211(2)). The rule interprets statutory and regulatory definitions and does not change the environmental effect of the Alternative Fuel Transportation Program regulations. DOE, therefore, has determined that the rule is covered under the Categorical Exclusion in paragraph A5 to Subpart D, 10 CFR part 1021. Accordingly, neither an environmental assessment nor an environmental impact statement is required.

#### E. Review Under the Paperwork Reduction Act

No new collection of information will be imposed by this rulemaking. Accordingly, no clearance by the Office of Management and Budget is required under the Paperwork Reduction Act (44 U.S.C. 3501 et seq.).

#### F. Review Under Executive Order 12988

With respect to the review of existing regulations and the promulgation of new regulations, section 3(a) of Executive Order 12988, “Civil Justice Reform,” 61 FR 4729 (February 7, 1996), imposes on Executive agencies the general duty to adhere to the

following requirements: (1) eliminate drafting errors and ambiguity; (2) write regulations to minimize litigation; and (3) provide a clear legal standard for affected conduct rather than a general standard and promote simplification and burden reduction. Section 3(b) of Executive Order 12988 specifically requires that Executive agencies make every reasonable effort to ensure that the regulation: (1) clearly specifies the preemptive effect, if any; (2) clearly specifies any effect on existing Federal law or regulation; (3) provides a clear legal standard for affected conduct while promoting simplification and burden reduction; (4) specifies the retroactive effect, if any; (5) adequately defines key terms; and (6) addresses other important issues affecting clarity and general draftsmanship under any guidelines issued by the Attorney General. Section 3(c) of Executive Order 12988 requires Executive agencies to review regulations in light of applicable standards in section 3(a) and section 3(b) to determine whether they are met or it is unreasonable to meet one or more of them. DOE has completed the required review and determined that, to the extent permitted by law, the rule meets the relevant standards of Executive Order 12988.

#### G. Review Under the Unfunded Mandates Reform Act

Title II of the Unfunded Mandates Reform Act of 1995 (Pub. L. 104-4) requires each Federal agency to prepare a written assessment of the effects of any Federal mandate in a proposed or final agency rule that may result in the expenditure by State, local, and tribal governments, in the aggregate, or by the private sector, of \$100 million in any one year. The Act also requires a Federal agency to develop an effective

process to permit timely input by elected officers of State, local and tribal governments on a proposed “significant intergovernmental mandate,” and requires an agency plan for giving notice and opportunity for timely input to potentially affected small governments before establishing any requirements that might significantly or uniquely affect small governments. The rule published today does not contain any Federal mandate, so these requirements do not apply.

#### H. Congressional Notification

As required by 5 U.S.C. 801, DOE will report to Congress the promulgation of this rule prior to its effective date. The report will state that it has been determined that the rule is not a “major rule” as defined by 5 U.S.C. 801(2).

#### List of Subjects in 10 CFR Part 490

Administrative practice and procedure, Energy conservation, Fuel, Motor vehicles.

Issued in Washington, DC on 16 April, 1999.

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Dan W. Reicher  
Assistant Secretary  
Energy Efficiency and Renewable Energy

For the reasons set forth in the Preamble, Part 490 of Title 10, Chapter II, Subchapter D, of the Code of Federal Regulations is amended as set forth below:

## **PART 490 - ALTERNATIVE FUEL TRANSPORTATION PROGRAM**

1. The authority citation for Part 490 continues to read as follows:

42 U.S.C. 7191, 13211, 13235, 13251, 13257, 13258, 13260-3.

### **[490.2 AMENDED]**

2. Section 490.2, Definitions, is amended by revising the definition of “Alternative Fuel,” to read as follows:

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Alternative Fuel means methanol, denatured ethanol, and other alcohols; mixtures containing 85 percent or more by volume of methanol, denatured ethanol, and other alcohols with gasoline or other fuels; natural gas; liquefied petroleum gas; hydrogen; coal-derived liquid fuels; fuels (other than alcohol) derived from biological materials (including neat biodiesel); three P-series fuels (specifically known as Pure Regular, Pure Premium and Pure Cold Weather) as described by United States Patent number 5,697,987, dated December 16, 1997, and containing at least 60 percent non-petroleum energy content derived from methyltetrahydrofuran, which must be manufactured solely from biological materials, and ethanol, which must be manufactured solely from biological materials; and electricity (including electricity from solar energy).

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